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Tests Show Increased Efficiency In Windmill Performance

By **A. F. Mohr**

Mem. A.S.A.E. Engineer, Hyatt Roller Bearing Company, Chicago, Ill.

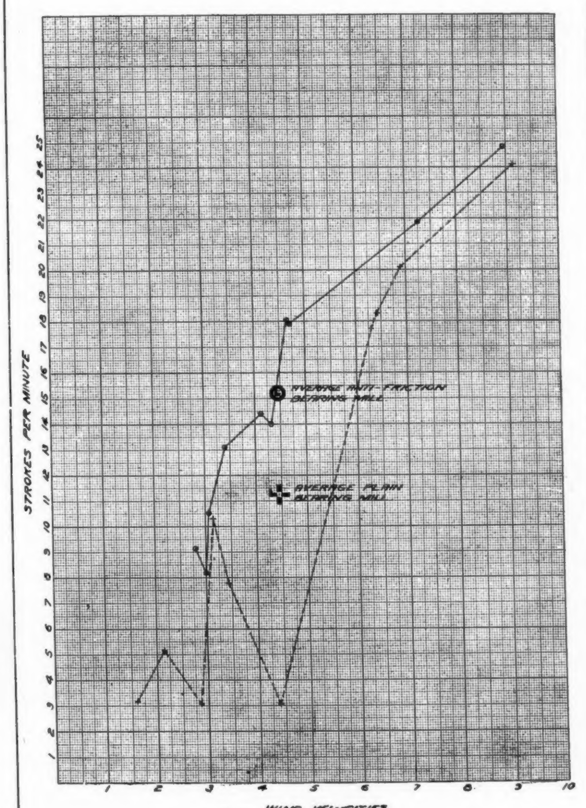
OF ALL existing forces that nature has so far permitted mankind to use as a source of power, wind and water are the cheapest. The abundance with which nature bestows these elements fluctuates from day to day but simple storage methods readily overcome this handicap. While water power is limited to certain localities, wind power is available everywhere, and this is one of the reasons why the farmer is the greatest user of wind power in the world. Another reason is due to the fact that a windmill of reasonable size and cost will pump sufficient water to supply him with all his needs.

The object of a windmill when used for pumping water is to convert the force of the wind into a vertical mechanical motion for operating a pump rod, and it is the aim of every good designer that the mechanism necessary to accomplish this be as efficient and require as little attention as possible. The early windmills while very crude in this respect, nevertheless served the purpose for which they were intended, but the trend of design in modern agricultural equipment is to make all improvements that will increase its life and make it deliver more, with less effort on the part of man, beast or the machine itself.

One of the handicaps in the operation of a windmill is the oiling problem and when driving through farming sections evidence is everywhere available that most mills suffer from lack of lubrication. The farmer can hardly be blamed for not wishing to climb a 50 or 60-foot tower. It is a hazardous business at best, and in the late fall or during the winter the risk of life and limb is just so much greater.

To lessen these dangers and to increase the efficiency as well as the life of the modern windmill, some mills are provided with anti-friction bearings that need attention far less frequently. Oiling these bearings once in three or four years, and at a time when conditions are most favorable for this work, is all the attention they require. Thus a dangerous work has been reduced to a minimum and time is saved which, of course, means a saving of money. But this is not all. These anti-friction bearings also save power, or, in other words, they increase the amount of power available for useful work.

In order to establish the actual gain obtained by this im-



Ability to run in lighter winds assures a more dependable supply of water. The chart shows test of identical mills with plain and anti-friction bearings

provement, two 8-foot mills were mounted on separate 50-foot towers. At various times tests of from four to seven hours duration were run on each mill during which the wind velocity, the strokes of the pump rods, and the amount of water pumped were carefully recorded. The wind velocity was determined by anemometer readings recorded every fifteen minutes. The strokes were counted with a regular mechanical counting device and the amount of water pumped was weighed every fifteen minutes.

To balance the possible difference between the efficiency of the pumps, the heads of the windmills, which included the anti-friction bearings, were interchanged often so that the results are entirely comparable. The accompanying table shows the average result of the runs on the two types of windmills.

To illustrate graphically the difference in performance of the two mills, the average number of strokes for the various average wind velocities have been plotted in the accompanying chart. The average strokes for the ten tests on both mills is also shown on this chart.

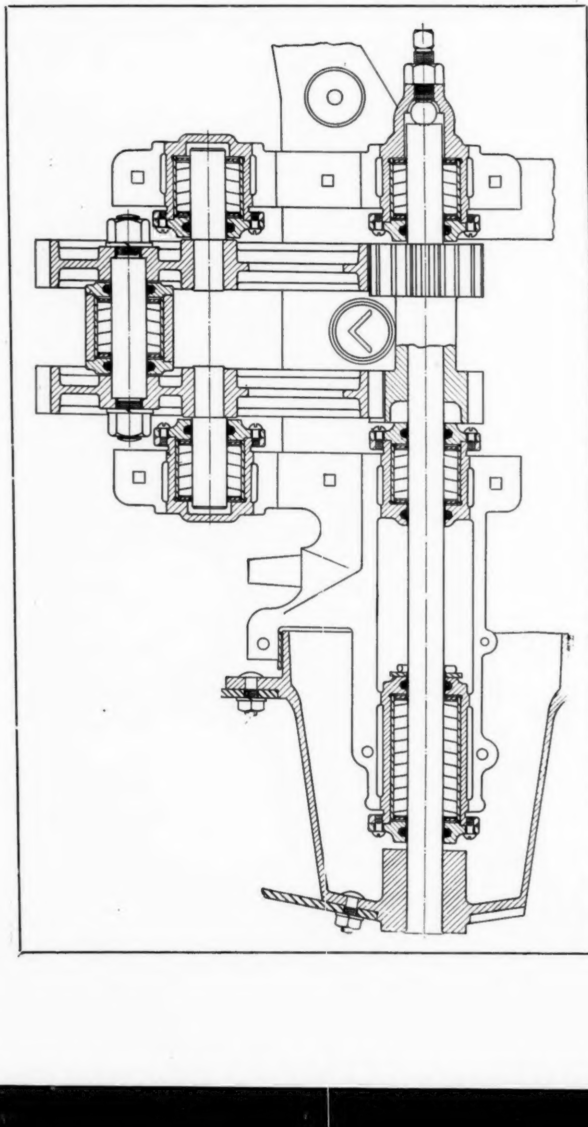
It will be noted that although the average wind velocity during the tests on the plain bearing mill is a trifle higher than during the tests on the anti-friction bearing mill, the latter shows nearly four strokes more per minute. Expressed in percentage, it shows that the mill with the anti-friction bearings delivered 34.9 per cent more water than the one with plain bearings.

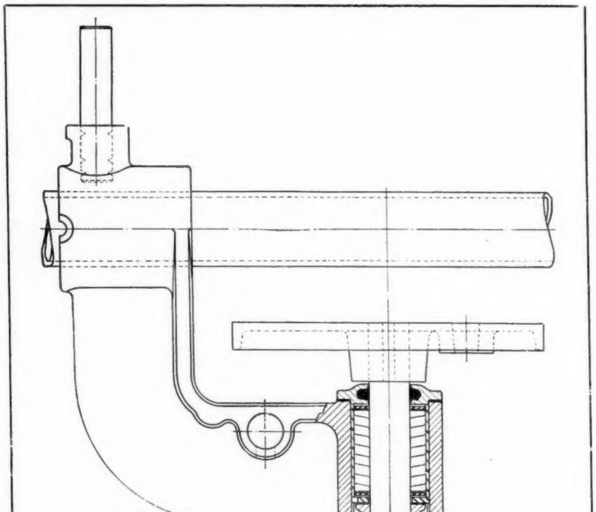
Another test was run on two 10-foot mills of the direct-drive type of windmill, mounted on 70-foot towers. The duration of this test was 370 hours and very careful measurements were made with devices properly calibrated. In this case the pumps were interchanged during the test so that the results are also strictly comparable. The only constructional difference between the mills consisted of two anti-friction bearings in place of two plain bearings on the main shaft. Although these bearings represent perhaps only one-half of the places where friction occurs, the mill with the two anti-friction bearings pumped 14 per cent more water. When it is considered that the back-geared mill of the former tests was equipped with anti-friction bearings at all five rotating positions, the result of this latter test is not at all out of proportion.

An interesting and very significant fact was established during these tests. It was noted that the anti-friction bearing mill would start to pump at a considerable period before the plain bearing mill and when the mill velocity was low the amount of the water pumped was as much as 50 per cent greater.

As the velocity of the wind increased the increase in water pumped gradually became less. This is due to the fact that windmills are fitted with governing devices which limit the speed of rotation of the wind wheel, and it therefore follows that as the mills approach the point where they both run at the same speed the frictional loads necessarily become alike.

Since the prevailing winds in this country are light, and furthermore, since most of the light winds occur during the summer when the demand for water is greatest, it becomes apparent at once that the application of anti-friction bearings





Above, a direct-drive mill with anti-friction bearings. At left, a back-geared mill with roller bearings on main and counter shafts and on crank pin

Windmill Tests With 8-Foot Stover Steel Mill

Anti-friction Bearing Mill					Plain Bearing Mill				
Test No.	Duration of Test	Average Wind Velocity M.P.H.	Average Strokes Per Min.	Average Water Per Stroke	Test No.	Duration of Test	Average Wind Velocity M.P.H.	Average Strokes Per Min.	Average Water Per Stroke
1	7 Hours	3.00	8.18	1 lb.	1	7 Hours	2.13	5.14	1 lb.
2	7 Hours	7.26	21.85	1 lb.	2	7 Hours	3.17	10.31	1 lb.
3	7 Hours	3.38	13.08	1 lb.	3	7 Hours	2.86	3.04	1 lb.
4	7 Hours	3.07	10.54	1 lb.	4	7 Hours	9.13	24.10	1 lb.
5	7 Hours	2.77	9.11	1 lb.	5	7 Hours	3.44	7.75	1 lb.
6	7 Hours	4.31	14.00	1 lb.	6	7 Hours	6.42	16.32	1 lb.
7	7 Hours	4.65	18.04	1 lb.	7	7 Hours	6.30	17.70	1 lb.
8	7 Hours	4.70	17.91	1 lb.	8	7 Hours	1.60	3.17	1 lb.
9	7 Hours	4.11	14.40	1 lb.	9	7 Hours	4.40	3.06	1 lb.
10	7 Hours	8.95	24.81	1 lb.	10	7 Hours	6.90	20.09	1 lb.
Average		4.619	15.19		Average		4.673	11.26	

to windmills is a genuine improvement of great economic value.

The anti-friction bearings are installed into these mills in such a manner as to retain the oil and prevent dust and other foreign matter from entering the bearing surfaces thus insuring long life and freedom from frequent oiling, and since they are non-adjustable they also require no attention in this respect. Severe weather conditions of either summer or winter have no effect on these bearings so that they are ready at all times to do the work for which they were intended. A grade of lubricant is used which remains fluid in the coldest weather and yet performs satisfactorily in the hottest climates. Accurate workmanship coupled with the use of a high-grade anti-friction bearing which reduces the element of wear to a minimum without question increases the life of this machine. This, of course, is another important consideration.

Summing it all up, it appears that real progress has been made in this equipment in that the amount of water delivered has been greatly increased, water is delivered under conditions when conventional types will not operate, the time required for oiling and other attention has been reduced to a minimum, and the life of the outfit has been lengthened.

Windmills embodying these improvements have been on the market for several years and thousands of them are proving to farmers the advantages of anti-friction bearings.

It is almost needless to say that the farmer is not only interested but is also vitally concerned in these things that really tend to make farming more of a pleasure and less of a task.

A Plea for Standardization Progress

Remarks by President E. A. White to Plow and Tillage Implement Manufacturers at Chicago, April 21, 1921

THE American Society of Agricultural Engineers, which I have the honor to represent, appreciates very keenly both the confidence which you have shown in asking us to cooperate with you and the responsibility which such work carries. We are endeavoring to place agricultural engineering on the foundation to which its importance entitles it. There has never been an organization in this country which offered an adequate clearing house for information on agricultural equipment and the American Society of Agricultural Engineers offers just such a clearing house.

Sometimes I feel the farm-equipment industry is suffering from hiding its light under a bushel. There are facts regarding elimination, etc., that should be made public. The industry will be strengthened; farmers and dealers will have more confidence if more of that information is gotten out into the proper channels.

The farmer should know that, when he demands a variety of tools, he is not only increasing manufacturing expense, but also the cost of operation of his farm, and he will never be in a position to understand that until he sees what the large number of styles and sizes mean in actual operating cost to him.

There is another idea which I would like to see developed in the industry. Most all other branches of agriculture have a background of scientific work carried on by the federal department of agriculture and state agricultural colleges throughout the country, but the fact remains that while agricultural engineering, and particularly farm implements, has probably contributed more than any other factor to the development and prosperity of agriculture, it occupies a minor position compared with other lines of agricultural endeavor, and that places your implement industry under a handicap.

Your standardization problems would be more simple and more easily solved if the United States Department of Agriculture was also working on those problems right now. There are big benefits to be derived if you will get things stirred up and create a demand upon our legislatures to enlarge appropriations to handle the agricultural-engineering departments at the state agricultural colleges.

It is time that we begin to work out a comprehensive definition of what standardization is, what it can accomplish, where it should begin, and where it should end. Standardization must not interfere with progress and development. It is going to take some time to effect real standardization.

The American Farm Bureau Federation is growing rapidly and its president has talked standardization. Standardization of farm machines is one of the things that is turning over in the back of their heads as a line of work that may be desirable for them to take up. With a strong farmers' organization making itself heard, you must face the possibility that some day they may come along with a certain definite program, and you will be in a better position to meet it if you are practicing standardization. It is one of the most far-sighted steps that you can take, and the time is now opportune. The American Society of Agricultural Engineers will be glad to help you in any way it can.

Farm Equipment Standardization From the Manufacturing Standpoint

By **G. W. Crampton**

Treasurer, Deere & Company, and Secretary Deere & Mansur Works, Moline, Illinois

MANUFACTURERS of other products have frequently expressed their surprise at the multiplicity of sizes and styles made by the farm-implement industry. This has been a matter of concern to the implement manufacturers themselves and it has been a subject of discussion at their annual conventions for years. While it was acknowledged that the evil existed and that the situation should be corrected, nothing was accomplished and the lines continued to expand.

Upon our entrance into the war, however, it became apparent that it would be necessary to conserve raw materials to the utmost. It was recognized that farm machinery was absolutely essential for the production of food to carry on the war successfully.

The War Industries Board, therefore, called upon the National Implement and Vehicle Association to reduce their requirements to a minimum and on February 26, 1918, a meeting was held at which eliminations were agreed upon. A pamphlet was issued by the association containing thirty-eight pages showing sizes and styles eliminated and retained.

With the exception of left-hand plows, several sizes of which have been restored to the line, this elimination program is still in force and I will discuss the effect which this has had upon the industry and the desirability of continuing and further extending this movement.

It would not be strange for one not familiar with this industry to ask: Why are there so many types and sizes and what has brought about the situation? The answer is briefly:

1. The pressure brought to bear upon the manufacturer by the salesman who sometimes explains his failure to secure orders by the statement that he could not offer the same type of machine as his competitor, or that he did not have a machine of a certain size or style to conform to the ideas peculiar to the locality reported.

2. The lack of appreciation by the average manufacturer of the difference in cost of manufacturing goods in small quantities; of the cost of development of new tools; of the difference in size of inventories; of the lost motion in sales effort, etc.

3. The manufacture of freak tools which have a temporary run. During the period when such tools are popular, other manufacturers are induced by "the demand of the trade" to add them to their line. A case in point is the "plow cut" disk harrow which has a reverse curve and whose action was supposed to resemble that of a plow. The name brought for several years a popularity which caused other manufacturers to make it also. Inferior action in the field finally caused its downfall, but not until considerable sums had been spent uselessly.

An illustration of the added cost of manufacture of goods in small quantities is shown in Chart A, which is self-explanatory.

The difference between ideal cost and actual cost can be readily seen from this chart. As a matter of fact ideal cost is shown in No. 3. Average cost would be somewhere between No. 2 and No. 3 while actual cost is shown in No. 1. If goods were priced at actual cost the price would be prohibitive, therefore, the profitable goods must carry the burden of goods made in small quantitites.

The chart does not tell the whole story, however, as costs are multiplied in other directions. Each setting of the dies usually results in the loss of trial pieces. It does not take into account extra tool room expenses, extra supervision and other overhead expenses.

Now in cases such as shown above, the excess cost over ideal or even average cost applies in other directions as will be shown later.

As an illustration of the result of making special tools for certain localities, I have had Chart B prepared showing the manufacture of stubble diggers and sugarland cultivators, also alfalfa cultivators and seeder attachments for these implements made by our company.

What actually happens in the case of these new tools and in the expenses incurred is as follows:

1. A trip of investigation including traveling expenses
2. The cost of the trial machines the first season
3. The expense of testing out experimental machines
4. The expense of building several test machines which are invariably scrapped at the end of the season.

After the final form is decided upon there is incurred the expense of drawing, dies, patterns, jigs, and templets. The cost of the above would not be less than several thousand dollars and it can be seen that in case of tools made in small quantities the "profits" of many years would be required to pay back development work alone.

This is but the beginning, however. Specifications and directions must be made; repair lists must be made and printed; and the cost is as much as on machines which are made in quantities. All the patterns must be carried as a part of the fixed investment for twenty years or more, even after the machines are discontinued.

Then there is the cost of advertising. In the printing of

B 881		
BEND 100 PIECES	HOURS AND COST	
Time Required For Bending 100 Pieces	PRODUCTIVE	NON-PRODUCTIVE
" " " Set Up Of Bending Die	¾ Hr. $1.08	
" " " Punching		¼ Hr. $ .72
Punching 1-13/16" - 2½" - 2-9/16" Holes	½ Hr. $ .35	
Time Required For Setting Up Punches and Gauges		¾ Hr. $ .51
Total	1¼ Hr. $1.43	1¼ Hrs. $1.23
9 Hours Production On Same Basis As Above 4 Changes (Approx. 100 Pcs.)	360 Pieces At Cost Of $3.55 Per 100	
9 Hours Production On One Pattern	620 " " " " $2.06 " "	
90 " " " " " Average Per Day	699 " " " " $1.535 " "	

While Above Comparative Production Cost Statement Is Based On Manufacturing Conditions, On A Run Of 90 Hrs. Or More It Would Be Safe To Assume That Manufacturing Conditions And Equipment Could Be So Changed As To Make Possible A Far Greater Reduction In The Cost Per 100

#1 Proportion of Set Up To Days Production Runs Of Approximately 100 Pieces

#2 " " " " " Day " On Basis Of All Day Run

#3 " " " " " (Per Day) On A 90 Hour Run

Chart A, showing excessive cost of small quantities

*An address delivered at the annual meeting of the plow and tillage implement department of the National Implement and Vehicle Association, Chicago, April 21, 1921.

YEAR	ALFALFA CULTIVATOR	SEEDER ATTACHMENT	STUBBLE DIGGER	NO.9 DISK CULTIVATOR
1906-07			135	231
1907-08			129	253
1908-09			46	156
1909-10	238		78	246
1910-11	1152	302	112	236
1911-12	1161	507	141	241
1912-13	1290	470	41	26
1913-14	864	376		15
1914-15	392	156	1	20
1915-16	278	98		31
1916-17	385	138	15	52
1917-18	401	150	53	136
1918-19	396	129	19	74
1919-20	325	148	37	189
TOTAL	6882	2474	807	1906
AVERAGE	625	247	57	136

Chart B, showing unprofitability of special tools

circulars the cost for special tools mounts rapidly. The designing, art work, and preparations are as much for small quantities as for large. Suppose the cost of such circulars was $150 and the machines were made in quantities of 150. This would be $1.00 for each machine made; if the same expense was incurred in a machine made in lots of 1500 the expense per machine would be 10 cents; if in lots of 15,000 the expense would be one cent per machine. This is illustrative of the measure in which costs expand throughout.

In the case of the alfalfa cultivator, the decline in sales shown on the chart is not due, as may be supposed, to the failure of the tool itself. There has never been a tool designed which is as effective for the purpose and we have never had anything but praise for it. Nevertheless, being made for a special purpose and for certain localities its sales possibilities are limited. For a few seasons its sales held up fairly well, but as soon as this sectional demand was supplied the trade declined and it can be seen that the average for the last five years is only 357. Nor is this all. If the machine had not been patented the chances are that similar machines would have been built by others, thus further dividing up this "lucrative" business.

The seeder attachment is a special tool,separate and apart from any other goods which we make. As a matter of fact, while the castings in this attachment are figured at our average price for castings the chances are that if we had them made by outside foundries they would cost 10 cents per pound.

Then in the case of the sugarland cultivator, naturally the territory is limited and the trade can never be profitable. Chart A shows a steel part belonging to this machine. To show that this is a grim reality and understated rather than overstated, I will say that I have known this piece to go on the bulldozer three times in one season, twice to fill small orders and once to supply extras.

There are only four concerns, as far as we are informed, who now make sugarland disk cultivators, while there are about thirty firms making disk cultivators. You will note that the general average for fourteen years is only 136. If each concern making disk cultivators should decide to add a

Effect of Eliminations on Plow and Tillage Implements

	Percentage of Production 1916-17	1919-20
Walking plows made in lots of		
1 to 100	66.47	47.44
100 to 200	14.00	12.82
200 to 300	5.53	6.41
300 and over	14.00	33.33
Wheel plows made in lots of		
1 to 100	77.22	63.96
100 to 200	7.59	13.42
200 to 300	5.49	6.36
300 and over	9.70	16.26
Cultivator frames made in lots of		
1 to 100	11.54	
100 to 200		13.33
200 to 300	11.54	13.33
300 and over	76.92	73.34
Cultivator rigs made in lots of		
1 to 100	44.20	29.59
100 to 200	18.12	16.32
200 to 300	7.97	19.39
300 and over	29.71	34.70
Harrows made in lots of		
1 to 100	21.81	
100 to 200	20.00	15.00
200 to 300	10.91	5.00
300 and over	47.28	80.00
Disk plows made in lots of		
1 to 100	52.94	42.10
100 to 200	5.88	21.05
200 to 300	23.53	10.53
300 and over	17.65	26.32

sugarland cultivator to its line, and assuming that the trade would be equally divided, it would mean that each company could be expected to sell an average of eighteen machines annually.

The above facts apply also to our beet tool line. These are built for territories where sugar beets are grown. After a locality is supplied future business is a question largely of replacement. We have found that when new sugar factories were being established the trade was good and we did not have enough tools. We would place large estimates the following season and something would happen such as a reduction in the tariff on sugar, and we would have enough tools to last for two or three seasons. Different sections use different planting distances, etc., and we find it necessary to get out new attachments and print new circulars every season.

If one concern had all of the trade it might yield a sufficient volume to make it pay, but divided among several it reduces the volume to a small amount. Nevertheless probably the "inducements" are such that other manufacturers will engage in their production.

As a matter of fact, tools which are not used practically in all sections of the country, such as potato machines, should be made in small shops equipped for that class of work. There are about ten firms engaged in the manufacture of potato planters. If all implement manufacturers should add them to their line it would hopelessly divide the business.

Chart C shows the number of sizes of certain tools made

SIZES AND STYLES					
IMPLEMENTS	1909-10	1910-11	1912-13	1918-19	1920-21
Disk Harrows	150	157	154	53	49
Spading Harrows	6	6	6		
Alfalfa Harrows	2	2	2		
Corn Planters - 2 Row	82	109	80	35	21
Cotton Planters - 1 Row	18	16	14	11	9

Chart C, progress in elimination of sizes and styles

by Deere & Mansur Works, Moline, Illinois. This, however, does not entirely cover the situation. For instance, in the case of planters which shows 109 sizes and styles in 1911, in addition to the number stated each style had eight adjustments and any style would be supplied in any one of the adjustments thus running the sizes into the hundreds. They now furnish only one setting for each style. This table also shows some further eliminations since 1918. The number of two-row planters now manufactured also includes cotton planters of which five styles are made, reducing the sizes of corn planters to sixteen.

The result of this standardization was due partly to the steel, coal, and railway strikes of 1919 and partly to unprecedented demands for automobiles and other articles. The prices of pig iron, coal, coke, and other materials were sharply advanced in the latter part of 1919. The price of implements was not advanced. Had it not been for the standardization program which enabled the manufacturers to effect economies the loss would have been severe.

Furthermore, the demand for implements in the spring of 1920 was unprecedented and the manufacturers were taxed to the utmost to meet requirements. In addition the strikes mentioned above delayed and in many cases prevented the delivery of materials. It is not difficult to imagine what would have happened if the implement industry had been burdened with the infinite variety of sizes and styles which prevailed in 1917.

One of the greatest accomplishments of standardization was the elimination of cutout disks. Most if not all of the manufacturers of disk harrows with round disks furnished cutout disks also in every size and style of harrow which they made. Some opposition to the proposed elimination developed on the ground that in certain conditions the cutout disk would do better work than the round disk and one firm refused to dispense with the cutout disk.

Notwithstanding this fact, however, the balance of the manufacturers eliminated cutout disks with the result that round disks are now chiefly used in sections where cutout disks formerly prevailed. It has been contended, however, that there are localities which still desire the cutout disks.

Having been connected with the company with which I am associated for many years and having observed the tendencies of the harrow trade, I have prepared Chart D which I might describe as showing the rise and fall of the freak disk. I have already mentioned the plow-cut disk which has become extinct. The chart, however, shows only the blades which depart from the round disk. You will note the spading or four-point disk manufactured in 1894. This is the cutout disk in its extreme form. If a cutout disk is desired this should logically be the most effective type. It only reached the sale of 183 and was discontinued in 1899.

The Morgan harrow was first made by Deere & Mansur Company in 1899 although it had been introduced and sold by others before that date. The work which it performed, or rather seemed to perform, made it popular for a time; in fact, there were many localities where neither the round nor cutout disks could be sold in competition with it. Its failure to turn the ground properly operated against its use.

While the spike-tooth harrow shown was not designed as a general-purpose harrow, but for renovating alfalfa, it illustrates another extreme departure from the round disk. Its popularity as is indicated was short lived.

We now come to the cutout disk which is shown in six-point and eight-point blades. Nine and ten-point blades have been furnished in some cases but these approach so nearly to the round disk that we will not need to consider them. The chart shows the quantities of the cutaways sold each year since 1894 and represents chiefly the six-point blades although some of the eight-point blades were furnished during the two years before elimination. To avoid confusion the

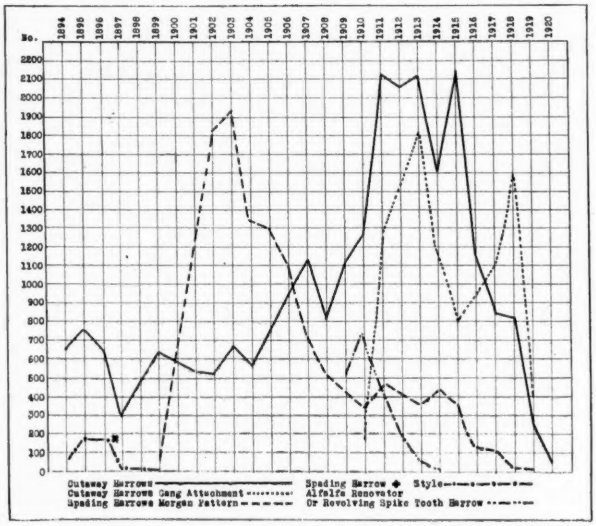


Chart D, rise and fall of modified disk harrows

rear gangs or tandem attachment are shown separately.

One fact must be borne in mind. The trade did not vary so much as the chart would seem to indicate for the reason that the trade on round disks varied in somewhat the same ratio. In other words, if the volume of round-disk harrows were shown it would be seen that the volume of cutout conformed largely to the trade on the round.

Another fact worth noting is that we were importuned from our leading cutout disk territory to make the eight-point blades in place of the six-point. We held out against this for several years on the ground that if it were true that the eight-point blade was better than the round disk, the six-point should be better than the eight-point. In other words, any argument advanced in favor of the eight-point blade would apply with still greater force in favor of the six-point, and if the eight-point performed better than the six-point, then logically the round was better than either cutout. Nevertheless, we were forced to supply the eight-point blade.

Naturally this raises the question as to whether or not this "trade demand" was psychological, and not based upon the actual work of the tool.

The case of the left-hand plow is somewhat similar but differs in certain respects. Manufacturers of left-hand plows were convinced that the making of this plow was expensive and that the plow itself was nonessential. The exigencies of the war caused its elimination, but the prejudice in its favor in certain localities seemed to be too compelling for the manufacturers to resist. Many of the plow makers restored it to their line reluctantly believing, as they did so, that the battle had been half won.

Having reviewed the difficulty of attempting any plan of standardization before the war, also the causes which led up to diversification of lines, having also stated the undoubted benefits to the maker and user of farm machinery, a word might be in order as to expectations for the future.

Granting that at least a part of the demand for so many different tools is the result of local customs based largely on psychological rather than actual needs, granting further that manufacturers have been all too ready to comply with the "demands of the trade" towards multiplicity, is it not fair to assume that any departure from the present plan of standardization will weaken the entire structure and cause a "reversion to type" of the standardization program?

Let us hope that the good sense of the manufacturers supported by that of the public will prevent such a catastrophe.

Special Problems in Open Ditch Design

By Quincy C. Ayers

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WITH a full realization that the practice of drainage engineering cannot yet be defined as an exact science, and with a ready admission of the necessity for basing many computations on unproved assumptions, nevertheless I feel that the time is at hand for drainage engineers to devote serious attention to hitherto neglected fields of drainage design. Theoretical study, research and accumulated drainage experience have added much to the common store of knowledge so that we may reasonably expect a rapid advance of the profession in years to come.

It is the purpose of this paper to present some thoughts on the interrelation of velocity, depth and breadth particularly applicable at junctions and at sharp breaks in grade. If the velocity can be controlled at these critical points, we can largely eliminate sedimentation and thereby reduce, if not abolish, maintenance costs. Of course, in some districts sufficient depth is the dominant factor, but even then there are few cases which do not admit of some variation.

Now the supporting power of a stream for silt carried in suspension is derived from the upward component of the velocity of eddies, and eddying is aggravated by high velocities and soothed by great depth. It follows, then, that the supporting power of silt-carrying capacity of water is likely to vary directly with some function of the velocity and inversely with the depth. Apparently this capacity is independent of width, but such is actually not the case, because the wider a stream is made the greater the number of eddies become having upward velocity components.

The total energy of any flowing stream may be expressed as the sum of its potential energy represented by the depth of flow and its kinetic energy represented by the velocity head, $\frac{v^2}{2g}$. For uniform flow the sum of these values remains constant no matter how much the amount of each may vary between themselves; if we increase depth we automatically decrease velocity head. By the same token, if we decrease depth we automatically increase velocity head, provided the slope remains the same.

Now as silt-carrying capacity is largely a function of velocity head, the problem at ditch and grade junctions is to keep the kinetic energy above a certain minimum value by varying the depth. This of course implies increasing width to care for a given discharge. As this minimum value of kinetic energy or velocity head just mentioned is a direct function of velocity, the same principle may be stated in simpler form by reference to some velocity value which is high enough to prevent silting and low enough to avoid erosion. We may designate this particular velocity, which is independent of width but varies with the depth, the "critical velocity."

In order to avoid silting in any canal, then, the mean velocity of the stream must not be kept constant throughout, but must be increased with the depth. This means that the common practice of suddenly increasing the depth of ditches to care for deep tile outlets without providing for an increase in velocity cannot be recommended as the deeper section is almost certain to collect large silt deposits.

In view of the foregoing, it would seem practicable to assume that a formula expressing the relation between critical velocity and depth could be developed. Such a formula would be of the form

$$(1) \quad v = fd$$

a homogeneous equation between v, the critical velocity, and d, the corresponding depth. R. G. Kennedy has proposed that this formula be expressed in the following form:

$$(2) \quad v = cd^m$$

where v and d have the same significance as before and c and m are constants to be determined by experiment. The author of this formula has made a number of observations on canals of various sizes in India which have been in service for a great length of time and, through a long process of silting and erosion, have finally reached a state of permanent silt equilibrium. From these investigations he deduced numerical values for c and m; namely, $c = 0.84$ and $m = 0.64$, which substituted in formula 2 gives

$$(3) \quad v = 0.84\, d^{.64}$$

v being the mean velocity in feet per second and d the depth in feet. The claim is made that this formula 3 is applicable to all ditches without regard to variations in size or to the character or specific gravity of silt. This contention is substantiated by E. C. Thrupp[2] who has shown from observations covering the entire range of velocity, depth and silt character, that Kennedy's findings are approximately true for all streams. Before final acceptance of these constants, judgment would of course demand many more supporting investigations, but, for the present, in lieu of such investigations, it is thought wise to accept them tentatively as a basis for study and further development. Corresponding values of v in formula 3 for assumed values of d are here given for convenience in computations:

$d =$	1	2	3	4	5	6	7	8	9	10
$v =$	0.84	1.30	1.70	2.04	2.35	2.64	2.92	3.18	3.43	3.66

d being expressed in feet and v in feet per second.

S. W. Frescoln[3] states: "For any practical ditch section having less than 1.5 feet fall per mile, Kutter's formula with $n = 0.030$ will give velocities less than the critical velocity, v, corresponding to the depth; or, in other words, for $n = 0.030$, all channels with fall less than about 1.5 feet per mile are certain to silt somewhat. Hence, for such cases, the only thing to do is to so proportion the channels that the liability to silt will be reduced to a minimum. It can be mathematically shown that for a rectangular channel and a given discharge the cross section that gives the least value to the expression $bd^{1.64}$ will have the least tendency to silt, and therefore this is the relation that should exist between the value of b and d for such cases. In general, this will give a comparatively small depth, but in the case of large channels it will not be less than is quite usual in design. For $n = 0.0225$, the limiting slope is about 0.75 foot per mile."

In conclusion, let it be said that, while it may not always be feasible to apply these principles in practice on account of prohibitive cost, they are certainly deserving of the most careful study in any economical drainage design. It is simply a matter of designing ditch sections in the ordinary way and then testing them for silting. If the velocity is less than "critical" for the given depth, estimate the cost of enlargement for the sole purpose of preventing or reducing silting and lay this against the cost of annual dredging operations necessary to maintain the original ditch sections.

Paper read before the Iowa Engineering Society, Des Moines, Iowa, January 19, 1921.

[1] Proc. Inst. C. E., Vol. CXIX, 1895, "The Preventing of Silting in Irrigation Canals," by R. G. Kennedy.

[2] Proc. Inst. C. E., Vol. 171, 1908. E. C. Thrupp.

[3] "The Prevention of Silting and Erosion in Watercourses," by S. W. Frescoln, drainage engineer, Office of Experiment Stations, U. S. Department of Agriculture, June, 1915.

The Maximum Use of Southern Land

By Jesse M. Jones
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VISION is the greatest force for progress in the world, and because America's engineers had this we owe much to them. This led them through the wilderness far from home and civilization and among hostile people while they were seeking out trackless empires and bridging barriers to them. This was long before the woodsman came with his axe to carve out a nation from the forest covering our great eastern United States. This feat was the greatest supreme task in human history.

We are interested in this woodsman who has become the farmer of today—the man called "the backbone of our country." Certainly it is he that has made and preserved us a nation.

Do our engineers of today possess this same fortitude? Does vision urge them the same? The best answer is "They have always measured up to the task confronting them, and there is every reason to believe they will always do so."

The problems today are as great as ever, although of a different stripe and kind than were met in the wilderness, the wild free lands of the West, which were later after the Civil War taken up by the thousands of acres. Gradually the areas of free or cheap fertile Government or public lands of the West are being occupied until today those remaining are far from transportation, and not desirable for a citizenship similar to that with which the South is acquainted.

Then came the United States Reclamation Act of 1902, which appropriated to the Department of the Interior $121,000,000 from the sale of public lands to be used for the irrigation of other public lands. Close to 800,000 acres are operated on the projects founded by the Reclamation Service.

There is only a comparatively small area of the dry lands of the United States that can be irrigated at a reasonable cost—one authority says 3,000,000 acres. One may well ask "Why should the Federal Government go to the enormous expense of putting water on dry lands when there is so great an area in the Southeast and North that needs to be and can very cheaply be made dryer, and when drained is easily worked, very productive and most profitable?" The answer is simple. "The United States Government went into the business of irrigating dry lands because it held title thereto, while the wet lands, particularly of the South and East, were never under federal control, but owned first by the state and then by individuals. Therefore public moneys could not be spent upon the development of them.

WET LANDS MUST BE RECLAIMED FOR SETTLERS

With the free public lands taken up and the reclamation projects being limited, where is the next area of low-priced productive land for the settlers? It must be the wet lands already mentioned, and the cutover lands contiguous thereto. There is some of this in all of the states east of the Mississippi river, but perhaps the greatest amount is in the Southern states, with the states of Michigan, Minnesota and Wisconsin next.

Be it remembered that we must never lose sight of the fact that the fundamental basis of the wonderful development and material wealth of this country, which has made it so powerful a factor in the world, is the land and the natural productiveness thereof which made home building upon it a stupendous success. Theoretically, those lands which are most readily and profitably worked should be the first to be put into cultivation, while those which are margined, or even farther removed, should be the last to be tilled.

What is the situation in the South? In the seven states, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama and Mississippi there are a total of 211,663,360 acres, of which 14,500,000 acres are permanently swampy at present and entirely out of the question for agricultural purposes. This leaves 197,200,000 acres capable of being utilized in one way or another for the purpose of bringing revenue into the coffers of the state, as well as to individuals. Of this area 57,600,000 acres are improved farm lands, then 17,300,000 acres are in virgin pine, still standing, and perhaps 2,000,000 acres of cypress, or in round numbers, 76,900,000 acres out of further use for the present. This leaves 121,200,000 acres of potentially possible agricultural lands in the Southern states.

ADDITIONAL MACHINERY WILL OPEN LARGER AREA

How can we so use all of this vast area that it will bring in revenue? "Use more machinery" is usually the first suggestion. There is no doubt but that this would add many acres to that already tilled, and it is a favorable thing to do, as it not only increases a man's efficiency but productive capacity as well. This is seen by comparing the production per man of certain sections of the United States that use two to four times as much machinery as is used per man on the farms of the South. The acres handled per man are also two to four times greater.

Three things are standing in the way of using more machinery in the South:

1. Stumps. A recent Wisconsin bulletin shows that in certain sections of that state stumps cause an actual waste of 12.7 per cent of the tilled area, or an annual loss of one bushel of potatoes per stump. In addition there is a waste of time and additional labor to get around them, not to mention the discomfort of tillage and disturbance of the peace of mind. Demonstrations and publicity with statistics as to money gained by removing stumps need to be used to get larger areas cleared, so that each day's labor may be more effective. It is hoped that much of the 12,500,000 pounds of TNT which the army is ready to turn over to the Department of Agriculture can be used in the South in connection with demonstrations to stimulate land clearing. Information on how to clear land is badly needed by the present farmer as well as new settlers coming in.

2. Lack of knowledge of machinery. Our average farmer is not an expert in the handling of complicated agricultural tools, but needs to be shown and taught, not only their operation, but how they are to be applied. It is to be deplored that the demonstrations in the use of farm machinery which prevailed so largely at the beginning of county agents' work have been done away with to a great extent, or are not continued with as much prominence. True a vast number of tractor demonstrations have been held and they have been most useful in stimulating the use of power machinery, but only comparatively few of our farmers are in position, or will be in position for years, to use tractors. These farmers need to be gotten to demonstrations showing the use of two and three-horse plows, disk and other harrows, cultivators, seeders, binders, and other machinery that takes two or more horses.

Paper presented at the Southern Section meeting of the American Society of Agricultural Engineers at Lexington, Kentucky, February 11 to 16, 1921.

3. Most of the terraces built are unsatisfactory for the use of larger machinery. Neither is this phase of the county agents' work as prominent as ten years ago. Demonstrations in the correct building of terraces need reviving, and publicity given to the economic value of proper terraces to stimulate the correct construction for preventing land washing, waste of land area, as well as increasing the output per man.

Above are outlined three ways of getting more land utilized by means of machinery, that greater revenue can be secured. However, the sparse population of the rural South cannot begin to handle all of the desirable land in this way. What other remedy is given?

Settle the land with new farmers. This is a most excellent prescription. Here are 121.200,000 acres available, plenty of land for every one. But where shall we get the men to go on it? We hear that in the North, Northwest, a young man cannot go on a farm as a hired hand and work up from there to a landowner, and still have much of life left to enjoy on the farm after he can call it his own. Some picture the rural sections of this country finally settled with tenants who can never acquire title to the land, except by revolutions similar to that of Poland, Mexico, or even Russia.

These situations may be explained by conditions in Kansas, where the average age at which a farmer becomes a landowner is ten years more than a little over a generation ago. Between 1875 and 1880 the average age at which a man became a farm owner was 24.6 years. In forty years this had increased to 34.6 years.

Immediately the idea is advanced that sections of the United States where these conditions prevail are excellent sources from which to get settlers and it is a valuable reservoir, but there is competition. Wisconsin, Minnesota, Michigan, and other states in that direction are calling them with their millions of acres of prairie and idle cut-over lands, many of which are undeniably valuable for agricultural purposes. The New England states, New York and Pennsylvania are beckoning to their thousands of improved but abandoned farms, many priced below the value of their improvements or their value for agricultural purposes.

Canada is in the market for seventy thousand farmers from this same source, and has raised $1,500,000 for the purpose of securing them to till its broad acres and help lift the burden of taxes from the shoulders of those at present owning the land. The railroads of that nation consider that they can afford to spend over $800 per family for this purpose. This is considerable competition for settlers, but there are still other sections that are bidding very strongly.

SETTLERS FOR THE RECLAIMED LAND IS A PROBLEM

How many new farmers are needed to settle the 121,200.000 acres available? If 85 acres are allowed per farm, which is the average size of those at present in these states, this means 1,426,000 farmers will be required, or at 4.5 per farm family, an increase in population of 6,415,370. At the rate of increase in population in these seven states during the last twenty years, it means that it will take 38 years to settle this unimproved area if every man, woman and child who takes up residence therein moves to the farm and none go to the city to provide a healthy growth there. Either there must be a speeding up of the colonization of land, or it must be put to other uses to prevent taxes and interest eating it up, for be it known that money invested in land or other securities at six per cent. compound interest, doubles itself in less than ten years. With taxes added this doubling of the investment in land takes place much quicker.

Before considering further use of the land, let us consider another source from which settlers can be obtained. I refer to our own southern boys, and after all they make the best farmers. Something needs to be done to keep more of them within the borders of their native states, because 15.4 to 25.2 per cent of the native born in six of these seven states have left, and their places have not been wholly taken by settlers from other sources. In Florida the per cent is 10.2 but it is new, therefore, not on the same basis as the others. While other inducements are needed, and ways must be made easier for these boys to secure a piece of land to call their own, the removing of stumps, and the building of proper terraces, which will allow the introduction of large machinery, will have much to do with keeping them.

If settlers are gotten from outside the South, and more of its own boys stay at home, several other things that directly affect them must be done that they may be able to bring more of their land into the production of greater revenue. I refer directly to means for the safeguarding of their health. The toll that malarial fever alone takes directly from every acre that is cultivated, and the many acres that it prevents from being cultivated, cannot be comprehended. In one section of the South alone it amounted in one year to over $15 per acre. For every death from malaria one may be certain there is a loss of 3,000 working days, which will greatly circumscribe the activities of any community. If to the enormous toll malaria takes from the revenues of land production are added the toll from typhoid fever and hook worm, it amounts to a sum in dollars and cents beyond the comprehension of any banker, not to speak of the distress caused to humanity. The attention of the engineers to drainage of wet areas and proper construction of buildings, or systems to handle sewerage, will make humanity free of these. They are engineering problems.

That the farmer may extend the acreage he handles, better farm buildings need to be erected, more efficiently laid out and properly repaired. Some work is being done along this line which should well be kept up. Then comes work of tile drainage of low farm areas and large drainage districts. You have already been told that there are between four and five million acres in drainage districts, completed, underway or are about to be undertaken.

There is another way I must mention by which a farm worker can be enabled to extend more effectively and very greatly the area he handles, and that is by making conditions more desirable for the housewife and about the farm home. Anything that adds to the comfort of the home helps the land attached to it. Some have gone far in this, but the number that do have things that make farm home life happier and easier are too few. You can well afford to keep up the activities of getting water works, lights, vacuum cleaners and washers in the home, as well as other home conveniences. But let us no longer use this word "convenience" but in its place use "machinery" or "equipment," for these terms really describe them. A convenience is something that can be dispensed with, but machinery is necessary for effective work. This is as true in the home as it is on the farm.

I have already explained a number of ways by which a larger per cent of the land can be utilized, and touched upon work for engineers to do and work that must be done, but all of the land cannot be made to produce revenue by any one or all of the means mentioned.

There is one more suggestion most men make for using idle lands, and it is usually the last one to be spoken of. It is to use the idle lands for raising livestock. Let us briefly look into conditions here. It is out of the question to consider hogs, because improved farm lands are necessary for their successful production.

What of sheep? There is little need to mention this industry, because their numbers have been decreasing steadily for many, many years.

Let us then turn to the consideration of grazing these millions of acres with cattle. Here there are great possibilities, and at best one can be grazed on every ten acres of unfarmed land in these seven states, but enormous strides must

be made if the land is to be used in this way.

At the rate at which cattle have been increasing for the last twenty years it will take 148 years before there are sufficient numbers in these seven states to graze the land if 8 acres are allowed per animal. The rate of increase of cattle is going to be faster and faster, because of the eradication of the cattle tick and the changes brought about by the advances of the cotton boll weevil.

Can it be rapid enough and if so what of the economic situation with relation to the United States as a whole?

We should also remember that if these 15,150,000 cattle should be grazed on southern pastures within the next ten years, there would be an overstocking of the markets of the United States, if not of the world. The number of cattle of all kinds in the United States today is 68,369,000.

There is need to go further, and there is only one answer that comes to us, which is this: If we are going to make all of our land produce revenue, we must grow forests on it in addition to farming or running livestock thereon. I do not wish here to discuss the depletion of our lumber supply, although that situation is bad enough, because we are cutting our timber five times as fast as we are growing it. In ten years there will be very little cypress left in the South, in fifteen years we will begin to import pine and other kinds of lumber, and in thirty short years cease to be an exporting country. That is, our imports will balance our exports. Surely you are interested in this attention, because it is the basis of all farm construction with which you come in contact.

For fifty years the saws have been humming in the South, and have cut the timber away from 66,400,000 acres of pine land, taxing the railroads to their utmost capacity to handle the products thereof. There is left only approximately 19,300,000 million acres of virgin pine and cypress uncut, 17,300,000 acres of which is pine.

The situation is not as black as it might be, because of the rapid reforestation which is taking place, and herein lies our hope for obtaining revenue from all of our lands. Twenty-three per cent of the pine acreage already cut is now ready to be cut again, and soon, by the additional growth which is already coming on, 25 per cent additional can be lumbered the second time. There is no place where the timber becomes ready to cut again more quickly than in these seven states under consideration. In twenty-five to thirty years much pine is ready the second time, and some even earlier where it is protected from fires and the land is drained. It has been observed that where reasonable drainage is given young timber land the growth is more rapid, hence my reason for bringing the proper drainage of these cutover areas to your attention.

There is every reason why the agricultural engineers of the South should work hand in hand with the foresters in the matter of reforestation. These engineering projects do not stop merely with the more rapid growth of forests, but the ditches and banks thrown up protect the land from fires by providing natural barriers to where sweet grass is growing in open areas among young trees, and at the same time removing many mosquito-breeding locations. Thus if the cutover lands are drained, reforestation takes place more quickly, the growth is more rapid, better grazing is provided for livestock, and the health of the residents is improved, all of which adds to the increased revenue of the 121,200,000 acres I have been referring to constantly.

Reforestation will not retard farm development, nor prevent the grazing of cattle on the same land, but it will provide a means for getting some revenue from land much of which is now bankrupt, and if not so used will remain so until it is needed for farms. A considerable portion of this is marginal lands, and cannot be economically cultivated for years to come. In fact, it is not needed at present. The sooner these states come to realize that they cannot immediately settle all of their cutover lands, nor graze them efficiently, the better it will be for all concerned.

Do not understand me to say, nor think that I infer that the land should permanently be kept in forests. I do say that by this means it can be made to produce revenue in lumber and forest products until ready for the plow, and that conditions which make for the growing of the timber also make for the improvement of livestock grazing lands, and the health of the residents, that is, the drainage of the land and prevention of fires.

Engineering Greatest Factor in Fostering Agriculture

By Dr. E. A. White

FROM the very nature of things agricultural engineering must continue to play a role of increasing importance in agricultural development. If it were not for the fact that the matter needs to receive more public attention it would not be necessary to show how the application of engineering principles to the arts and practices of agriculture have resulted in decreasing the cost of production, increasing the profits, and improving living conditions upon the farm. The forces which are grouped under the general head of agricultural engineering have had more influence than any other class of factors ordinarily grouped under one head in fostering agricultural development and shaping the courses of the arts and practices of agriculture.

A close study of the situation reveals tendencies which clearly indicate that we are entering into a new agricultural era. We are passing from the pioneer to the business stage. In the past very little attention has been paid to cost of production or profits from farm operations and still less to improving the farm home. On the whole, the farmer has been content to get along by cutting his expenditures down to a minimum and taking his profits from the increase in the price of the land. Now the situation has changed. We are reaching a point where the end of government land is in sight. The value of land has advanced. The farmer is beginning to study the cost of production and is realizing that farming operations must pay profits for the labor and energy expended and the interest on the investment. The conditions brought about by this change will call for taking up of the slack in our agricultural operations and offer an unusual opportunity for the agricultural engineering profession to render service of great value.

In the past the farmer, as a class has not been a user of professional service and this is perhaps the greatest obstacle in the path of the development of agricultural-engineering service for the farm. There is need for such service and perhaps the opportunity for its development will be accelerated by the large holdings of land which are now in the hands of urban dealers who are in the habit of employing the services of professional men.

When one considers the service which engineering has rendered to agriculture in the past and the need for similar work in the future, it is difficult to understand why the profession of agricultural engineering has not made more rapid development. Perhaps this can be attributed largely to the fact that many leading men in agricultural work lack a conception of what engineering means and the professional engineer has been loath to give attention to agricultural problems as such because there was not the promise of financial reward held out by other fields. It may take some time to establish agricultural engineering on the basis which the service warrants, but the potential possibility exists, and it is a long road which has no turn.

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Development of Farm Electric Light and Power Plants

By L. S. Keilholtz
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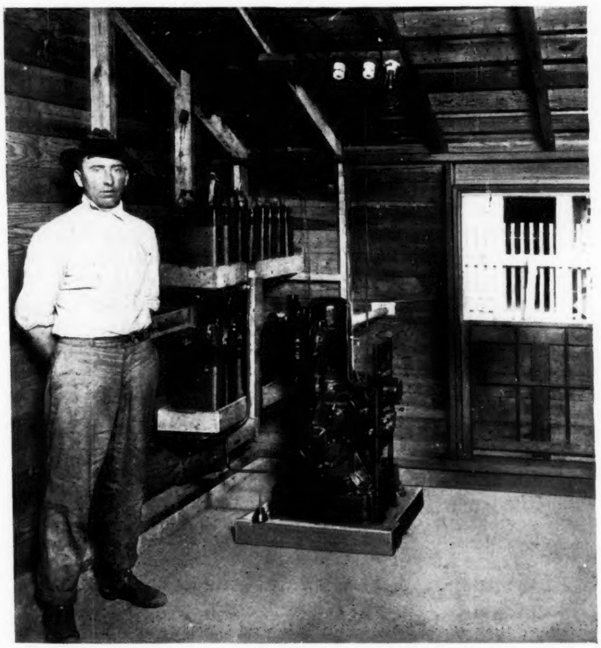
YOU remember the story of the backwoodsman who declared, with profane certitude, as he stood by the side of the first locomotive engine he had ever seen, "They'll never start her!" Then when the engine presently went puffing on its way down the track he as promptly declared, "They'll never stop her!"

Here are two opinions promised, it is evident, upon insufficient observation. A lot of people have been prone to like error in times past and we shall probably have people like it among us for a long time to come. Many are coming to realize, however, that it isn't safe to say any more that a thing can't be done, because someone who doesn't know it can't be done just comes along and does it.

Let those of us who have been privileged to make our own observations for as much as twenty years think for a moment of the things that couldn't be done twenty years ago, things that, in the language of Octavus Roy Cohen's cullud folks, nowadays we "don't do nothin' else but."

Automobiles, phonographs and tractors occur to us at once as striking examples and we can begin to include the airplane in view of the rapid strides it is making.

One of the most striking developments of the present day is the farm electric light and power plant. Here is something that farm folks wished for and engineers strove for, for several years before anything like satisfactory results were obtained. These hopings and strivings were not in vain, to be sure, for they served to keep the idea alive until the right tack was finally taken and lighting plants were produced that were sufficiently efficient and practical to warrant their adoption by farmers generally.



It is a mistake to try to economize on space in placing the electric outfit. They take up only a few square feet if given all the space they should have

It might be of interest to observe the trends and tendencies that have been manifested so far in electric plant development as it relates to the modern gas engine outfit. The earliest plants were built solely upon the idea of expediency. The farmer, it was assumed, had a gas engine. It didn't make much difference either about that engine, as to type or capacity. Then he was advised to look around and pick up an electric generator and belt it to his gas engine. He was supposed then to have an electric plant that would provide the benefits of electricity in his home—electric light, power and heat.

The fact that he did not get these benefits in all their fullness was responsible for certain distrust and disfavor which were felt for some time regarding the whole electric plant proposition.

A few of the faithful, however, knowing that basically the idea was right kept plugging away, and looking back we can appreciate the distance that has been traveled since the original inception of this idea. In the plain gas-engine-generator days, it was common practice to cart the engine anywhere about the place for ordinary gas engine jobs, and it often followed that at the time they wanted that engine to make light, it was otherwise engaged, maybe on the farther side of the farm. Presently the storage battery was included in the outfit. The electricity was available, theoretically, anyway without running the engine all the time and a step had been taken toward the ideal electric plant for the farm.

INTRODUCTION OF SELF-STARTER AN IMPROVEMENT

Another step was the introduction of the self-starter eliminating hand cranking and making it possible for the farmer's wife to operate the plant and secure electricity as she wanted it, adapting the gas engine somewhat to the job of generating electricity. People began to see the folly of running a five or six-horsepower engine to turn a one-half-kilowatt-hour generator and engines more nearly fitted for the work were adopted; the question of fuels was attracting attention and some experimenting was done with kerosene with the idea of using it to augment a gasoline supply already showing signs of diminishing and, incidentally, to provide a cheaper fuel.

It will be noted that the tendency of these steps has been in the general direction of increased convenience and ease of operation. Better efficiency and greater dependability were sought, of course, and were achieved in a measure as the years went on.

I think the direct-connected electric plant was an expression of the desire for a means of getting electric service more conveniently with greater ease of operation than it had previously been afforded for the farmer. There may be some difference of opinion as to the comparative merits of direct-connected and belted electric plants. Possibly there always will be this difference. At present, however, the trend seems to be toward the direct-connected plant and some of these, it might be observed, have met with marked success, judged even by the standards of this greatest age of mechanical and electrical development in the world.

In referring to the direct-connected plant as an outgrowth a later development of the electric plant as first expressed in the belted job, we are not unmindful of some early attempts at building direct-connected units. These are largely full-automatic plants and judged by present-day standards

were hardly satisfactory. One can hardly say to what extent automatic features can be employed in the modern electric plant, or what further successful developments may be made in the line of automatic lighting plant attachments. They should be as nearly automatic as is consistent with the most dependable and positive operation. That goes without saying. Automatic attachments should stop short, however, of the point where efficiency and certainty of continuous performance are sacrificed to what might seem like a temporary advantage or a good sales point. We cannot lose sight of the fact that here is a piece of equipment that is to be installed out on the farm, miles from where expert attention can be given it perhaps. Then the character of electric service is such that any interruption of it is particularly aggravating and undesirable.

We must not forget that electric service is the *summum bonum*, the sole aim in view when we make an electric plant. It doesn't matter to the user whether the plant is big, little, square or round, black, yellow or pink, so long as it will start off when he calls on it and deliver its rated amount of current for the needs of his establishment. That is the thing manufacturers have been striving for and, along with that, convenience and ease of operation, safety and dependability, so that nobody will be afraid to stand alongside the plant and start it up, and so that any member of the family can care for it if need be.

AN IMPORTANT DEVELOPMENT IS AIR COOLING

Air cooling has been an interesting development in lighting plant engineering. There is a close relation, we find, between air-cooling and kerosene fuel. While the water-cooled motor must operate at a temperature not higher than 212 degrees Fahrenheit, the air-cooled motor will attain a considerably higher temperature, a temperature that will insure proper combustion of the gas derived from kerosene. For the kerosene problem has been one of combustion, not of carburetion as was long supposed. With the simplest mixing valve as a carburetor, with a proper combustion chamber and adequate temperature, kerosene can be made to develop more power and show greater efficiency in the air-cooled gas engine than the gasoline we know today.

The question of voltage in the farm-lighting plant has been given a lot of consideration. Low voltage or high voltage? There are conditions where the low voltage plant, thirty or thirty-two volts, offers much the better system. Take the farm home of average size or smaller, where the farm buildings are grouped closely as they usually are. Larger sized wire will be necessary with the 32-volt system than with 110, but there will still be a saving where a storage battery is used, since the low-voltage plant will call for but fifteen or sixteen battery cells, where a 110-volt system will require fifty-five or fifty-six cells.

Where buildings are widely scattered, where long runs of wire are necessary, wire sizes in 32-volt would be too large to be practical. Here a 110-volt system with smaller wire for transmission lines would be less expensive probably than the low-voltage plant.

There is little choice between the high-voltage or low-voltage plant from the standpoint of accessories. All the electrical accessories used today in the farm home can be had as readily for 32-volt systems as for 110 and will render as satisfactory service. It should be remembered, of course, that while the low-voltage system will be satisfactory for operating lamps and motors that are properly installed and connected, special wiring circuits of proper sized wire should be installed for heating devices, such as flat irons, electric toasters, percolators and the like. A single example will make this clear. The ordinary electric flat iron requires five amperes when used on the usual high-voltage system. To secure the same wattage output on a low-voltage system would require eighteen amperes, which is too much for the ordinary lamp socket. Twenty-ampere receptacles and attachment plugs, with No. 10 transmission wire for the circuit, will make it perfectly safe and will assure satisfactory service with household electrical heating devices.

There are a number of points which should be observed in lighting plant installation. One of these is the location of the plant. The plant should be placed in or very near the building where the largest amount of current will be used. This will save long transmission lines of large wire, which would be necessary, if the plant were placed some distance away. For example, don't place the electric plant at the house if there is only a moderate usage of current there, while it is planned to run a milking machine twice a day at the barn with ½, ¾, or 1-horsepower motor.

Then the plant should be placed out from side walls or partitions, far enough so that one can work around it handily. Once in a while a plant gets placed beneath a porch, behind a stairway or back in a corner, in locations where service attention can be given only with great difficulty. It is never necessary to install a plant this way and it is a mistake to try to economize on space in placing the electric outfit. Most of them are so compact that they take up only a few square feet of room if they are given all the space they should have.

In disposing of the exhaust line, it must be remembered that this gets hot. Care must be taken to place it where attendants will not be running into it unnecessarily. It should not run close to the battery cells and must not touch woodwork or weatherboarding. There are several ingenious devices for disposing of the exhaust so that any objectionable noise is eliminated.

One might go on at considerable length in a discussion of features of the farm electric plant which have for their object the prime purpose of improving farm electric service, of enabling the farmer to get electricity from his own plant with a minimum of care and supervision on his part and with all the benefit and satisfaction that he has a right to expect.

The rapidly increasing number of electric plants on the farm testify to the satisfactory lighting plant design and construction already achieved, and they offer considerable promise of other triumphs ahead of us in this comparatively new and most interesting field.

Comparative Life of Split and Round Fence Posts

SOME people believe split fence posts last longer than do round ones. Probably as large a number hold the opposite view. The Forest Products Laboratory of the United States Department of Agriculture says that one will last about as long as the other if the percentage of heartwood and sapwood is the same in both. If the percentage of sapwood is increasd by splitting, the split post will be less durable, while if the percentage of heartwood is increased it will be more durable than the round one. Exceptions to this should be made if the posts are of spruce, hemlock, or any of the true firs, whose heartwood and sapwood are about equally durable.

If the posts are to be treated with creosote or some other preservative, the round post is preferable to the split, because of the comparative ease with which the sapwood can be treated. Experiments at the laboratory demonstrate that the heartwood faces on split posts do not, as a rule, absorb the preservative as well as does the sapwood.

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Investigation, Experimentation and Research

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CORN BELT FARMERS' EXPERIENCE WITH MOTOR TRUCKS (A study of 831 reports from farmers who own motor trucks), H. R. Tolley and L. M. Church (U.S.Dept.Agri.Bul. 931 (1921), pp. 34 Figs. 3.) This bulletin summarizes the experience with motor trucks of 831 grain and livestock farmers in the corn belt who have motor trucks for use on their farms.

The average size of the farms is 347 acres. Only 14 per cent of these farms are less than 5 miles from market and 20 per cent 15 miles or more, the average distance from market being 8 miles. A little over one-fourth of these men have changed their markets for at least a part of their produce since purchasing trucks, the average distance to the old market being 7 miles and to the new one 18 miles. Fifty-seven per cent of these men have not reduced the number of their work stock since purchasing trucks, 25 per cent have disposed of one or two head, and 18 per cent of more than two head, the average reduction for all farms being 1.2 head. It is considered apparent that to a large extent the motor truck supplements rather than supplants the horse on the farm.

The rated capacity of the trucks varies from ½ to 2 tons. Seventy-one per cent are rated at one ton and only 9 per cent at less than one ton. Experience caused 57 per cent of the farmers to select the 1-ton size as best, 25 per cent the 1½-ton size, and 12 per cent the 2-ton size. About one man in four decided that a truck larger than he now owns is better suited to his conditions. Ninety-one per cent of the farmers believed that their trucks will prove profitable investments. The principal advantage of a motor truck is the saving of time, and the principal obstacle to its use is poor roads.

As compared with horses and wagons, it was found that the trucks save about two-thirds of the time required for hauling to and from these farms. The roads on which nearly 95 per cent of the trucks usually traveled are all or part dirt, and on the average there are over eight weeks during the year when the trucks cannot be used on account of the condition of the roads. The condition of the roads prevented the use of trucks with pneumatic tires a little less than seven weeks during the year and of those with solid tires a little over nine weeks.

Twenty-four per cent of the trucks are equipped with pneumatic tires, 27 per cent with solid tires, and 49 per cent with pneumatics in front and solids in the rear. Fifty-eight per cent of the farmers are of the opinion that pneumatics are best, 25 per cent that solids are best, and 7 per cent that pneumatics in front and solids in rear are best.

These farmers have return loads for their trucks about one-third of the time, and the majority still use their horses for some hauling on the road. On more than half of the farms all the hauling in the fields and around the buildings is still done with horses and wagons. About 40 per cent of the farmers did custom work during the year, the average amount received being $132. It is estimated that these trucks travel an average of 2,777 miles and are used 112 days per year.

The average cost of operation, including depreciation, interest on investment, repairs, taxes, fuel, oil, and tires is estimated at 15.2 cents per mile for the ½ and ¾-ton trucks, 15.2 cents for the 1-ton, 21.3 cents for the 1¼ and 1½-ton, and 25.8 cents for the 2-ton trucks. The average cost of hauling crops, including the driver's time at 50 cents per hour, was 24 cents per ton-mile with the ½ and ¾-ton; 24.1 cents with the 1-ton; 23.3 cents with the 1¼ and 1½-ton; and 21.5 cents with the 2-ton trucks. It is stated that about one truck in fifteen could not be operated more than 5 days, and one owner in forty reported a loss of more than 5 per cent of the time when using his truck.

Half of these farmers own tractors as well as motor trucks on the larger farms. Only 33 per cent of the men whose farms contain 160 crop acres or less own tractors, while 65 per cent of those with over 320 crop acres own them. The number of work stock kept on farms where both trucks and tractors are owned is only slightly less than the number kept on farms of corresponding size where only trucks are owned.

SURFACE PURIFICATION of SEWAGE, W. D. Scouller (Surveyor and Munic. and County Engineer, 58 (1920) No. 1511 pp. 447,448). Studies on the various stages in the purification of sewage passing through a percolating filter are reported. An inclined galvanized tube eight feet long and six inches in diameter, containing one inch clinker obtained partly from a mature filter, was first used, settled sewage being dripped in at the upper end. To increase the length a surface 34 feet long made of half iron pipes 3½ inches in diameter was also used.

It was found that "(1) when sewage is passed over a surface in presence of air the organic matter is gradually deposited and forms a tenacious slime. (2) The organic matter first deposited is that kind which gives rise to sulphuretted hydrogen when fermented anaerobically. (3) The slime has the property of withdrawing colloidal matter from sewage, and acts also as a reducing agent. (4) Disintegration of the slime began ten weeks after starting the experiment, and coincided with the appearance of small worms. At the same time nitrification set in. Oxidation thus appears to be related to slime disintegration. (5) Nitrification was never noticed after the sewage traveled ten feet, and probably could not take place in the first 16 feet, because of the thickness of the slime. (6) The free and saline ammonia which disappears from the settled sewage was not all recovered as oxidized nitrogen in the effluent (7) The purification of sewage depends on the rate of treatment, or, in other words, varies with the surface used. A course filter is usually constructed with large material at the bottom, and graduated so that finer material is on the surface. The reverse process of having large material at the top and finishing with the smaller material below the center would probably prove more efficient."

Studies on the process of removal of sulphuretted hydrogen from tank effluent by filters using the same apparatus showed that "(1) sulphuretted hydrogen (8-10 parts S. per 100,000) in a solution of tap water is mostly absorbed by the slime after traveling ten feet, when passed over surfaces which have previously been treating sewage, probably as sulphid. Part is converted into sulphate (about 15 per cent), but this is largely increased when the apparatus is resting. (2) A weak solution of sulphuretted hydrogen (2 parts S. per 100,000) is retained after traveling ten feet, and nearly all after four feet, but it is all recovered by oxidation to sul-

phate. (3) The slime absorbs sulphate from sewage, but the records are insufficient to show what actually happens to the sulphate."

STUDIES ON CORN HARVESTING MACHINERY, M. Conti. (Rev. Facult. Agron. y Vet. (Buenos Aires) 3(1920), No. 1 pp. 25-32, Figs. 4.) Two corn harvesters developed after three years' study at the Experimental Institute of Agricultural Mechanics at Buenos Aires are described. One is adapted for the cutting of green corn for silage, and consists of an inclined knife between forked iron frame parts which receive and cut the standing corn, allowing it to fall on a platform where it is properly loaded. Two men and three horses are required.

The second machine is adapted for the harvesting of dry corn and also requires two men and three horses. The knife is a circular saw-edged type revolving at between 180 and 200 revolutions per minute, and is actuated by a wheel on the ground. Both machines are said to have been satisfactory under test.

THE SUPPLY, THE PRICE, AND THE QUALITY OF FUEL OILS FOR PUMP IRRIGATION, G. E. P. Smith (Arizona Sta. Bul. 92(1920) pp. 393-423, Figs. 7). The results of studies of fuel oils for use in pump irrigation in Arizona are reported. These lands include data on price and on tests. A set of specifications for fuel oils is also included, based on the special tests of samples of fuel oil at the station.

It is concluded that an adequate supply of gasoline and kerosene appears to be assured for at least a year. Engine distillate, gas oil, and twenty-seven-plus—the oils most used for pump irrigation—are being withdrawn from the market in California. A new source of supply of much promise is the north Texas and Oklahoma field. It is stated that contracts for the year's oil supply should be made during the winter by each farmer.

It is further concluded that the price of gasoline will fluctuate constantly with changes in the demand and production. Kerosene likewise will fluctuate in price, but it should be cheapened somewhat by a reduction in the present freight rates. It is considered likely that gas oil will remain at about the present price level, and that the price of Diesel engine fuel will always approximate that of boiler fuel oil, and will be considerably less than prices of the lighter oils. It is stated that steam power plants using boiler fuel oil or coal cannot furnish power at a cost low enough for pump irrigation districts.

With increasing demand it is shown that the tendency is to force the quality downward in gravity to the heaviest grades that the respective engines can burn. In this connection it is stated that fuel oils should be purchased with specifications, and those given are recommended for California gas oil for the present. Important features of the specifications given for California gas oil for pumping engines of the four-cycle electric ignition type are as follows:

The specific gravity shall be above 38 degrees Baume; the flash point shall not be over 120 degrees Fahrenheit and the burning point not over 150 degrees Fahrenheit. The oil shall not contain a measurable quantity of acid, either free or liberated during evaporation. When distilled in a standard 100 cc. Engler flask, by the U. S. Bureau of Mines method, the temperature, when 20 per cent is distilled, shall not be over 375 degrees Fahrenheit, when 90 per cent is distilled not over 500 degrees, and when 50 per cent is distilled not over 410 degrees, nor over the average of the temperatures for the 20 per cent and 90 per cent points. The oil shall not contain any water, sand, paraffin wax, or free carbon, or any visible solid substance and shall not contain over 0.2 per cent of sulphur.

RESULTS GIVEN IN BELGIUM BY TRACTORS, E. Leplae (Jour. Soc. Natil. Agr. Belg. S(1921) No. 7 page 49-53). The results of a survey of the work of sixty-seven tractors on Belgium farms, varying in size from 75 to 1,250 acres, are reported. Of these forty-eight varied in size from 125 to 500 acres. Forty-two out of forty-five tractor owners seemed satisfied with the tractor as a source of farm power.

The soils on the farms varied from sandy loam to heavy clay. Plowing was the principal work of the tractor on these farms, the depth varying from six inches to ten inches. It was found that the average tractor will plow from 2.5 acres to 7.5 acres per 10-hour day, according to the depth and type of soil. It was also possible to cultivate from seven to twenty acres, disk from ten to thirty acres, roll from 12½ to 25 acres, harrow from 12½ to 50 acres, harvest from 7½ to 17½ acres of grain, mow 7½ acres of hay, and thresh from 120 to 200 sacks of grain.

Of forty-seven tractors fifteen used kerosene and thirty-two gasoline as fuel. It was found that when plowing eight inches deep on loam soil at the rate of about 6¼ acres per day, the consumption of gasoline was from 3.2 to 3.7 gallons per acre. On heavy loam or clay soil the gasoline consumption was from 3.7 to 4.3 gallons per acre when plowing at the rate of about five acres per day. The consumption of kerosene was a little less than that of gasoline, the difference never exceeding a half gallon per acre. The consumption of lubricating oil varied from two to five quarts per day.

More than half of the tractor owners employed an ordinary farm hand to operate the tractor and the remainder employed either trained mechanics or operated the tractor themselves. As to accomplishment, it was found that one tractor will plow five acres per day, while one man and a three-horse team will plow a little over an acre per day to the same depth, or a tractor and one man will replace on plowing five men and fifteen horses. The tractor supplants from four to nine horses and from nine to twelve oxen, depending on the size of the farm.

The main advantage of the tractor recognized by the Belgian farmer is the quickness of excution of farm work, and the majority reporting were satisfied with the quality of the work. The main disadvantages of tractors noted are high purchase price, heavy expense of repair parts, fuel and lubricant, complicated mechanism, rapid depreciation, difficulty of obtaining skilled operators, and difficulty of use during wet weather.

INVESTIGATION OF THE FARM MACHINERY BUSINESS IN MINNESOTA. J. H. Hay (Minn. Dept. Agr. Bul. 10 (1920) pp 27. This bulletin reports the results of an investigation of the practices prevailing in the manufacture and distribution of farm machinery in Minnesota and of the prices and profits involved in these activities.

It is shown that the costs of labor and material used in the manufacture of farm implements for the years 1914, 1916, 1918, and 1920 equaled and in many cases exceeded factory prices of farm implements for the same years. The manufacturers within recent years have eliminated almost all the jobbers and wholesalers from the distributing part of the machinery business, apparently for the purpose of establishing a more direct route between factory and farmer and to reduce expensive distribution. This move did not translate itself, so far as was learned, into a reduction of price to the consumer.

It is further stated that exclusive contracts between manufacturers and local dealers are now considered obsolete, and all retailers are practically on a cash basis.

Data on prison machinery manufacture and on the activities of implement associations in the regulation of retail prices are also included.

SUMMARY OF INVESTIGATIONS ON EFFECT OF TILE DRAINS IN THE LIME OR PRAIRIE SECTION OF ALABAMA, L. A. Jones (Alabama Sta. Bul. 214 (1920), pp 99-107, Figs. 2).

This report, prepared in cooperation with the U. S. Department of Agriculture, describes the methods of obtaining data and analyzes some of the results obtained in an extensive study of the action of soil water in tiled prairie land and of run-off from lands, for the purpose of securing data as to the most satisfactory spacing and depth of tile drains. The experimental field is located 5½ miles southeast of Montgomery, and the soil is typical Houston clay, known locally as lime land or prairie soil. It varies in color from black to light gray through various shades of brown and red. The black soil occurs in the lower land and is practically uniform for a depth of four feet. The red, brown, and gray soils occur in irregular areas over the hillsides and are underlaid at a depth of from 2 to 4 feet by a gray clay containing lime concretions, or by rotten limestone.

The locations of the various soils and the arrangement of the tile lines are shown by plats. Most of the tile lines are spaced 75 feet apart and are laid from 3 to 3½ feet deep. The remainder are spaced 100 feet apart and are four feet deep.

The rise and fall of the ground water were determined by the use of test wells made of four-inch drain tile set four feet deep with the tops nearly flush with the surface of the ground. Open wells were maintained near the tile wells in a number of cases as a check on the water elevations. It was found that the elevations in the tile wells and in the open wells never varied more than 0.05 feet and that they were identical during the greater part of the time.

The dynamiting of these soils with one-half-stick charges of thirty per cent dynamite did not appear to improve drainage conditions.

The general elevation of the soil water during the spring months in tiled land was from 2 to 2½ feet below the ground surface, while that in untiled land was from 1 to 2 feet below the surface. After heavy rains, the soil water in tiled land returned to an average depth of from 2 to 2½ feet within two or three days after the storm, but in the untiled land the saturation remained within a foot or two of the surface for from five to ten days. Tile placed from 3 to 3½ feet deep gave better drainage in the prairie soil than tile placed from 2 to 2½ feet deep, because it lowered the line of saturation to a greater depth. It is thought that tile lines should never be placed more than six inches into the limestone hardpan underlying the prairie soils, and its distance below the surface should govern the depth of the drains where the hardpan is less than three feet from the surface of the ground.

The main outlet drains in the systems studied were designed for a capacity of ½ inch of run-off per 24 hours. The run-off investigations showed that the outlets rarely discharged to capacity for more than 3 or 4 hours at a time, and that the discharge decreases rapidly after the rain ceases. In designing a system of underdrainage for the prairie section, it is believed that a run-off of from ⅜ to ½ inch per 24 hours for the area tiled should be used, this depending on the amount of watershed draining onto the tiled area. If there are surface inlets into the tile drains a run-off of at least ½ inch should be used. There is nothing in the data collected to show that a run-off of ¼ inch would not provide satisfactory drainage, but where rainfall is as frequent and as intense as it is in the prairie section during the winter and spring months, it is considered advisable to provide plenty of outlet capacity.

Test wells placed ten feet apart showed that the soil water curves between the tile lines have the greatest slope near the tile, the slope gradually decreasing as the distance from the tile increases. The effect of the drains was not marked at a distance greater than thirty feet.

Emissivity of Heat From Various Surfaces in Warm Air Furnace Installations, V. S. Day (Ill. Univ. Engin. Expt. Sta. Bul. 117 (1920) pp 31). This bulletin reports tests of heat-insulating materials and surfaces made as part of an investigation into the efficiencies and capacities of warm-air furnaces and their proper installation. Tests were made by means of low-pressure steam-heated drums surrounding a central steam header from which the drums drew their supply of steam. The drums were ten inches in diameter and twenty inches long, and were made of the metal and with the covering to be tested. Steam was condensed in the drums by the cooling action of the air around them, and the weight of condensate gave a measure of the heat loss. One drum of bright tin not insulated was used as a control. Results are given from 160 tests on 26 surfaces, and the more important are as follows:

Drum No.	Description of Surface	Relative Percentage Efficiency as Heat Insulator
1.	1C tin, not insulated, bright	100.0
1a.	Same as No. 1 with ash-dust sifted on 1/16 inch deep	89.0
2.	1C tin with 1 thickness of 10-lb. asbestos paper	61.5
3.	1C tin with 3 thicknesses of air-cell asbestos and 1 thickness of 10-lb. asbestos paper	226.0
4.	1C tin with 2 applications of gray paint (of zinc, linseed oil, and lithpone composition)	57.5
7.	1C tin nickel plated and polished	96.0
8.	Galvanized iron, No. 28 U. S. S. gauge	96.0
9.	Black iron, No. 28 U. S. S. gauge, very rusty	54.0
10.	Surface and drum No. 3 with IX tin casing surrounding, with 5/16-inch air space and with six ½-inch vent holes cut in the casing	183.0
12.	Same as No. 10, but with vents stopped	216.0
15.	Same as No. 10, but with the air space packed with dry JM asbestos cement	142.0
18.	Galvanized iron (drum No. 8) with three thicknesses of air-cell asbestos and one of 12-lb. paper.	222.0
19.	1C tin (drum No. 2) with 4 thicknesses of 12-lb. asbestos paper	76.5
20.	1C tin with one thickness of asbestos paper covered with a firm coating of white calcimine (for determining the effect of light and dark surfaces)	62.5
21.	Galvanized iron (drum No. 8) with 1¼ inch asbestocel blocks covered with ½-inch of asbestos cement with a cheesecloth wrapper	392.0
22.	1C tin (drum No. 2) with 5 thicknesses of 12-lb. asbestos paper	89.0
23.	Same as drum No. 20 with lampblack calcimine on the surface used in that test	60.5
26.	1C tin (drum No. 2) with eight thicknesses of 12-lb. asbestos paper	101.5

The heat loss with one thickness of asbestos paper was found to be 39 per cent greater than with bare tin, resulting in a waste of 5 per cent or more of the coal consumed in the average house furnace. The heat loss from warm-air furnace pipes is considered to be a serious item. In the case of asbestos-paper-covered pipes the heat loss was about 23 per cent of the heat of the air at the bonnet above the inlet air temperature. When the pipe was of bright tin this loss was about 17 per cent of the heat available. Double-wall-tin pipes were found to be very efficient and easy to construct and install. The heat loss through galvanized iron was no greater than through bright tin of the same gauge. Bakelite lacquer on bright tin gave a slight increase in heat loss and did not prevent rusting of the metal when exposed to steam laden air for long periods. An enormous increase in heat loss was caused by painting bright tin pipes, and similar losses occurred as a result of painting asbestos paper covering, but in the latter case there was a moisture-proofing effect. The accumulation of dust and dirt on the pipes did not greatly alter the amount of the loss. The protection from convection currents of air by joists and studding also did not greatly affect the loss.

A. S. A. E. Affairs and Related Engineering Activities

Council Meeting at Davenport

THE Council of the Society held its second meeting of the year at the Blackhawk Hotel, Davenport, Iowa, April 29. There were present at this meeting I. W. Dickerson, J. B. Davidson, F. N. G. Kranich, Raymond Olney, President E. A. White, and Secretary Hanson.

In considering the revised Constitution, By-Laws, and Rules of the Society, the outline of which was approved at the annual meeting of the Society in December and later submitted to membership ballot, the Council decided that the new constitution should go into effect June 1, 1921. It was also decided that the new admission fee of $10 should also go into effect on that date, but that the new membership dues should not go into effect until January 1, 1922.

During the meeting President White appointed the Finance Committee provided for in the revised constitution, consisting of F. C. Fenton, chairman, E. V. Collins, and J. B. Davidson. This committee will begin its new duties on June 1.

The Council okehed the new directory prepared by the Secretary and ordered that it be printed and placed in the hands of the membership as early as possible.

Future policy and plans respecting the publication of AGRICULTURAL ENGINEERING, the Journal of the Society, were given lengthy consideration by the Council. The Publication Committee through its chairman pointed out the necessity of putting organized effort behind advertising sales in order that the Journal may not only be put on a self-supporting basis as early as possible but also make up the deficit which it has already created. By unanimous decision of the Council, The Power Farming Press, St. Joseph, Michigan, which has been printing and mailing the Journal since the first of this present year, was requested to draw up a three-year contract effective June 1, 1921, for continuing the publishing of AGRICULTURAL ENGINEERING, with the understanding that Raymond Olney, chairman of the Publication Committee, have complete supervision and direction of advertising sales in addition to the editorial work and be directly responsible to the Council of the Society for carrying out the policy and plans which it may decide upon from time to time for the best interests of AGRICULTURAL ENGINEERING and the Society.

Recognizing that the county agricultural agent is one of the chief spokes in the dissemination of accurate, reliable agricultural-engineering information to farmers, the Council discussed at some length a proposal to institute a plan for interesting the county agents in subscriptions to AGRICULTURAL ENGINEERING in case they were not eligible to or could not be interested in taking out memberships in the Society. While it is the policy of the Society to disseminate information without charge, it was not deemed advisable at the present stage of the growth of the Society to make subscriptions to county agents purely complimentary. Accordingly the Council decided that county agents should be offered AGRICULTURAL ENGINEERING at a special subscription rate, which would cover the cost to the Society of placing the Journal in their hands.

The Council also approved advertising rate card No. 2 and advertising contract blank submitted by Mr. Olney as chairman of the publication committee.

After considerable discussion the Council unanimously agreed that the next annual meeting of the Society should be held in Chicago, Illinois, December 27, 28, and 29, 1921. An effort will be made to secure the Auditorium Hotel as the place of meeting. In considering the program for the annual meeting the Council favored giving Tuesday afternoon, December 27, to the Reclamation Section; Tuesday evening to the College Section; Wednesday morning and afternoon to farm structures; and Thursday to farm power and machinery. Several prominent men were considered as speakers at the banquet of the next annual meeting and the chairman of the Meeting Committee was authorized to arrange for their appearance.

E. R. Wiggins, chairman of the local committee to organize a section of the Society in the tri-cities, reported that it did not seem advisable to organize a section there at the present time. The suggestion that members of the Society located in the tri-cities meet once a month for noon luncheon seemed to be feasible and would not only afford a closer acquaintance of the local members but unquestionably would pave the way for the organization of a section later.

The Council authorized the chairman of the Standards Committee to submit to the membership letter ballot on standards for farm wagons and drawbar location on farm tractors which have been approved by the Standards Committee. A proposal to hold an agricultural-equipment standards conference some time during the year was presented by Dr. White and discussed at some length, the Council authorizing the President to call such a conference if he deems it advisable.

The petition for the organization of a Reclamation Section and the constitution submitted for such section was approved by the Council.

Four-Year Course in Agricultural Engineering At Texas

THE faculty of the Agricultural and Mechanical College of Texas, College Station, Texas, has established a four-year course in agricultural engineering which will be in the engineering school. The course as outlined seems to be of the type in which engineering rather than agriculture predominates.

The freshman year's work is confined to general engineering together with the usual amount of English, mathematics, and material science. In the sophomore year certain courses in agriculture and agricultural engineering are introduced, together with a continuation of general engineering subjects. In the junior year agricultural engineering is more strongly represented, and electives make their appearance. In the senior year specialization in agricultural engineering becomes pronounced, the elective subjects being continued. These electives, by the way, are subject to the approval of the head of the agricultural-engineering department.

Excluding all general subjects, such as mathematics and drawing, it appears that agricultural engineering contributes

most of the specialized subjects, aggregating thirty-nine hours, civil engineering follows with twenty-three hours, mechanical engineering with eleven, and electrical with five. The agricultural subjects include eight hours of animal husbandry, twelve hours of agronomy, four hours of horticulture, and seven hours of farm management. The course provides for only twelve hours of electives, and while this amount seems small it seems likely that it is not through a desire to limit elective subjects but to their being crowded out by courses deemed of such importance as to be required.

The department of agricultural engineering at Texas A. & M. College is in charge of Daniels Scoates, an active worker in the Society as a whole and in the Southern Section, and the Society's president in 1918. While the information reaching the Secretary has not touched upon this point, it seems reasonable to infer that the advanced action of Texas in this matter is due in large part to the leadership and achievement of Prof. Scoates.

Agricultural Engineers at Ames Hold Annual Banquet

THE sixth annual banquet of the agricultural engineers of the Iowa State College was held May 5 at Ames. The banquet was given by the student branch members of the Society, and was the largest yet held at Ames. The programs were in blueprint form, hand lettered in regular engineering fashion. The menu was refreshingly free from kitchen French, consisting of a facetious dovetailing of the subject matter of agricultural engineering with the every day names of attractive foods. In addition to the student branch members the Society was represented by Prof. J. B. Davidson, head of the department, J. E. Waggoner, of the advertising department of the International Harvester Company, who received his A. E. degree at Ames in 1910, and Secretary F. P. Hanson. The toast program shows Prof. A. W. Turner as toastmaster, Prof. Q. C. Ayres as a speaker, and Deans Curtiss and Marston as honored guests.

New Constitution Adopted

THE REQUIRED two-thirds vote of the voting membership of the Society on the new Constitution, By-Laws and Rules recently submitted for membership ballot has been received, which constitutes final adoption by the Society. The revised instrument will become effective June 1, 1921, except the annual dues which the Council decided at its meeting in Davenport, Iowa, on April 29, should become effective January 1, 1922. However, the admission fee of $10 for new members provided in the new Constitution will become effective after June 1, 1921.

As provided for in the New Constitution the new Executive Council will consist of nine members instead of five, and will consist of President E. A. White, chairman; first vice-president, W. G. Kaiser; second vice-president, E. R. Jones; treasurer, Frank P. Hanson; F. N. G. Kranich and Raymond Olney, the two last retiring presidents; and I. W. Dickerson, F. A. Wirt, and J. B. Davidson, the three elective members.

Agricultural Engineering Show at Texas A. & M. College

ON APRIL 19 the department of agricultural engineering at the Texas Agricultural and Mechanical College of Texas, College Station, Texas, held an agricultural-engineering show. So far as is known to the Publication Committee this is the first show to be conducted by an agricultural-engineering department independent of other departments.

The college has turned over to the agricultural-engineering department a farm of more than one hundred acres as a field laboratory. One of the interesting features of the show was a suggestion box in which those in attendance were invited to deposit their suggestions as to what name should be given to this farm. As an evidence of the substantial interest taken in agricultural engineering and in this show in particular, it may be mentioned that a prominent tractor manufacturer provided three tractors to be given as prizes to the persons offering the three names considered most desirable by the judges. The announcement of the judges' decision is expected soon.

Three tractors also were offered as prizes to the three boys in three school grades writing the best essays on what they saw at the agricultural-engineering show. While a certain amount of advertising value will arise from the manner of giving away these tractors, it is to be construed chiefly as a generous appreciation of the value of agricultural engineering in promoting agricultural progress and prosperity, on which the farm-equipment industry depends for its welfare.

The exhibits included displays of farm gas engines, home conveniences, multiple-cylinder gas engines, oxy-acetylene welding, gas engine and tractor trouble shooting, automobile and truck chassis, soldering and forging, ignition, starting, and lighting systems, tractors, tractor rebuilding, farm machinery. There was in connection also an automobile show by motor-car dealers of Bryan, Texas. The nature of these displays varied with the subject matter, consisting in some cases of equipment on display, apparatus in operation, demonstrations of processes, and cutaway machines in motion. The various exhibits were conducted by members of the agricultural-engineering staff assisted by a large number of students. The society may well congratulate Prof. Daniels Scoates and his staff and the Texas A. & M. Student Branch both on the character of the show and the work they are doing to promote better engineering in agriculture.

Personal Items of Members

J. D. CHAPPELL sales and advertising manager of the General Ordnance Company, New York City, is on an extended trip through South America in the interests of his company.

TRUMAN E. HEINTON, formerly in the agricultural engineering extension department at the Ohio State University, is now assistant extension engineer of the agricultural engineering department of the University of Nebraska.

ELMER JOHNSON is at present stationed at the Delta Laboratory, Tallulah, Louisiana, where he is engaged in work on cotton-dusting machinery.

E. T. PERKINS was chairman of the reclamation session at the third annual convention of the Mississippi Valley Association, held May 2, 3, and 4, at New Orleans, Louisiana.

J. HOWARD REES, formerly connected with the Ohio Municipal Equipment Company, is now president of the Rees Motor Company, manufacturers of high-grade light cars, located at 211 Commerce Building, Columbus, Ohio.

EDWARD P. STAHL, sales engineer for the Hyatt Roller Bearing Company, New York City, has been appointed by President White to represent the American Society of Agricultural Engineers at the A. S. M. E. Congress at New York City.

WILLIAM W. WIARD has recently been elected president of the Syracuse Chilled Plow Company, Syracuse, New York. Mr. Wiard was formerly vice-president of that company.

New Members of the Society

MEMBERS

Edward W. Ahrendt, superintendent of experiments, International Harvester Company, Neuss on Rhine, Germany.

Frederick Earl Brown, mechanical designer, Columbia Tractor Company, Anderson, Indiana.

Bernis B. Browne, instructor power farming, Y. M. C. A. Automotive School, Portland, Oregon.

Henry N. Edens, chief engineering and works manager, The John Lauson Manufacturing Company, New Holstein, Wisconsin.

Conrad Erwin Frudden, engineering manager, Hart-Parr Company, Charles City, Iowa.

George Richard Holeton, instructor in farm mechanics, Provincial School of Agriculture, Olds, Alberta, Canada.

Alfred Mathewson, agricultural representative, E. I. du Pont de Nemours & Company, Wausaukee, Wisconsin.

Thomas Chase Mead, associate professor of agricultural engineering and irrigation, University of Idaho, Moscow, Idaho.

John Maxwell Meyers, experimental engineer, General Motors Corporation, Pittsburgh, Pennsylvania.

Charles W. Pendock, president and general manager, Le Roi Company, Milwaukee, Wisconsin.

Gustave Howard Radebaugh, assistant professor department of mechanical engineering, University of Illinois, Urbana, Illinois.

Elmore Preston Ross, president the E. W. Ross Company, Springfield, Ohio.

Carl Joseph Sonander, superintendent of experiments, International Harvester Company, Norrkoping, Sweden.

Harold W. Stoddard, agricultural sales and service division, Hercules Powder Company, Wilmington, Delaware.

Oscar Van Pelt Stout, consulting engineer and president and general manager of The General Farming Corporation, Lincoln, Nebraska.

William Warr, mechanical engineer, The Manhattan Rubber Manufacturing Company, Passaic, New Jersey.

Wayne H. Worthington, chief engineer, Aultman-Taylor Machinery Company, Mansfield, Ohio.

ASSOCIATE MEMBERS

Richard S. Boonstra, in charge of service schools, J. I. Case Threshing Machine Company, East Lansing, Michigan.

Harold Robert Chipman, agricultural engineering specialist, Agricultural College, Mississippi.

Raymond C. Cosgrove, sales engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

Harrison E. Fellows, conductor of schools, service superintendent in field work, J. I. Case Threshing Machine Company, Racine, Wisconsin.

Guy A. Hart, U. S. drainage engineer, U. S. Department of Agriculture, Box 1125, Montgomery, Alabama.

W. C. Howell, instructor gas engines and tractors, Agricultural College, Mississippi.

Mrs. Mary A. Ives, experimental household engineer, Agricultural Engineering Company, Columbus, Ohio.

Arthur T. Logan, salesman, King Ventilating Company, Owatonna, Minnesota.

Wayland Magee, farmer, Bennington, Nebraska.

Irvin D. Mayer, farm and cement products bureau, Portland Cement Association, Chicago, Illinois.

Joseph William Pincus, vice-president Zionist Society of Engineers and Agriculturalists, New York City.

Edwy B. Reid, editor "Farm and Home," Chicago, Illinois.

Robert Alex Rutherford, consulting engineer, Cedarhurst, Long Island, New York.

Herbert Lowe Sohnker, farmer, Rock Tavern, Orange County, New York.

Jean L. Vincenz, Chamberlin & Vincenz Engineers, Fresno, California.

Frank B. White, vice-president and counsellor on agricultural advertising, farm markets and community development, Arthur M. Crumrine Company, Chicago, Illinois.

JUNIOR MEMBERS

David E. Ball, assistant hydrographer, U. S. Reclamation Service, Yakima, Washington.

Ernest C. Downing, farmer, Sioux Rapids, Iowa.

Truman Edward Hienton, extension agricultural engineering Ohio State University, Columbus, Ohio.

J. Alden Werden, farmer, McHenry, Illinois.

Applicants for Membership

Albert Chester Dann, manager of experimental and designing department, Oliver Chilled Plow Works, South Bend, Indiana.

Kenneth R. Ames, manager department of farm buildings department, Gordon-Van Tine Company, Davenport, Iowa.

John Reese Adams, realtor with John H. Adams, consulting and mining engineers, Birmingham, Alabama.

Charles R. Armour, instructor in mechanical drawing, Rockford High School, Rockford, Illinois.

William Francis Maloney, agricultural student, Connecticut Agricultural College, Waterbury, Connecticut.

William Renwick White, assistant professor of agricultural education, State College, Pennsylvania.

Fred K. Baxter, salesman, J. I. Case Threshing Machine Company, Kansas City, Missouri.

Fred L. Sage, chief draftsman, Samson Tractor Company, Janesville, Wisconsin.

John Wiloughby Randolph, assistant professor of agricultural engineering, Alabama Polytechnic Institute, Auburn, Alabama.

Earl Stone Patch, engineer of tests, Samson Tractor Company, Janesville, Wisconsin.

James Herbert Stowell, agricultural department, Ford Motor Company, Minneapolis, Minnesota.

David Victor Fette, farmer, Hannibal, Missouri.

Frank Richmond Schubert, works manager, U. S. Ball Bearing Manufacturing Company, Evanston, Illinois.

Herbert C. Birkett, instructor in agricultural engineering, University of California, Davis, California.

Hubert Avery Hatfield, specialist on tractors and power implements, Box 104, St. Henry, Montreal, Canada.

George T. O'Maley, proprietor and owner G. T. O'Maley Ford Sales and Service, Kansas City, Missouri.

John H. Merrell, general manager, Manhattan Rubber Manufacturing Company, Chicago, Illinois.

David Beecroft, directing editor, Class Journal Company, New York City.

Harold David Lewis, instructor in agricultural engineering, North Carolina State College, Raleigh, North Carolina.

Wilbur L. Powers, chief in soils, Oregon Agricultural College and Experiment Station, Corvallis, Oregon.

John Benton Runnels, district manager, Western Electric Company, Ind., Kansas City, Missouri.